FLEXURAL BEHAVIOUR OF CONTINUOUSLY SUPPORTED FRP REINFORCED CONCRETE BEAMS

M N Habeeb

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M N Habeeb

B.Sc. , M.Sc., PGCE HEP, MIFL, CEng.

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School of Engineering, Design and Technology (EDT)

University of Bradford, UK

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ABSTRACT

Keywords: Concrete beams, Flexure, FRP bars, Steel, Composites, Deflection, Simply Supported, Continuously supported.

This thesis has investigated the application of CFRP and GFRP bars as longitudinal reinforcement for continuously supported concrete beams.

Two series of simply and continuously supported CFRP and GFRP reinforced concrete beams were tested in flexure. In addition, a continuously supported steel reinforced concrete beam was tested for comparison purposes. The FRP reinforced concrete continuous beams were reinforced in a way to accomplish three possible reinforcement combinations at the top and bottom layers of such continuous beams.

The experimental results revealed that over-reinforcing the bottom layer of either the simply or continuously supported FRP beams is a key factor in controlling the width and propagation of cracks, enhancing the load capacity, and reducing the deflection of such beams. However, continuous concrete beams reinforced with CFRP bars exhibited a remarkable wide crack over the middle support that significantly influenced their behaviour.

The ACI 440.1R-06 equations have been validated against experimental results of beams tested. Comparisons between experimental results and those obtained from

simplified methods proposed by the ACI 440 Committee show that ACI 440.1R-06 equations can reasonably predict the load capacity and deflection of the simply and continuously supported GFRP reinforced concrete beams tested. However, The potential capabilities of these equations for predicting the load capacity and deflection of continuous CFRP reinforced concrete beams have, however, been adversely affected by the de-bonding of top CFRP bars from concrete.

An analytical technique, which presents an iterative procedure based on satisfying force equilibrium and deformation compatibility conditions, has been introduced in this research. This technique developed a computer program to investigate flexural behaviour in particular the flexural strength and deflection of simple and continuously supported FRP reinforced concrete beams.

The analytical modelling program has been compared against different prediction methods, namely ACI 440, the bilinear method, mean moment inertia method and Benmokrane's method. This comparison revealed the reliability of this programme in producing more enhanced results in predicting the behaviour of the FRP reinforced beams more than the above stated methods.